



Outcomes of second-look percutaneous nephrolithotomy in renal calculi—a single centre experience

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Cite this article as: Kumar S, Karthikeyan VS, Mallya A, Keshavamurthy R. Outcomes of second-look percutaneous nephrolithotomy in renal calculi—a single centre experience. Turk J Urol 2018; 44(5): 406-10.

ABSTRACT

Objective: Percutaneous nephrolithotomy (PCNL) carries significant potential for morbidity. Scant data exists on indications and outcomes of second-look PCNL after a failure to completely clear renal stones at the first attempt. We present our experience with second-look PCNL.

Material and methods: This was a retrospective record review of 922 patients who underwent unilateral PCNL at a tertiary care center in South India. Baseline patient, stone characteristics and outcomes were compared between 844 patients undergoing primary PCNL and 78 patients requiring second-look PCNL.

Results: Increased stone complexity in terms of Guy stone score (GSS), stone size, staghorn calculi and stones in multiple locations were significantly associated with primary treatment failure ($p < 0.001$). Operative time > 75 min had a significant association with need for second-look PCNL and complications. Initial PCNL was discontinued due to bleeding (28; 35.9%), pelvicalyceal system perforation (3; 3.9%) and purulent urine leading to urosepsis and hemodynamic instability (2; 2.6%). Staged PCNL was done in 44 (56.3%) patients. During second-look PCNL, new access tracts were necessary in majority (42; 53.9%) of the patients and multiple tracts in 20 (25.6%) patients. In second-look PCNL, complications were comparable to primary PCNL ($p = 0.289$).

Conclusion: Second-look PCNL should be advocated in patients where the initial PCNL was discontinued due to bleeding, perforation of collecting system, prolonged operative time (> 75 min) and in patients with large stone burden.

Keywords: CROES-Clavien complications; primary PCNL; second-look PCNL.

Introduction

Percutaneous nephrolithotomy (PCNL) is the preferred treatment for renal calculi except for few extremely large and complex renal calculi due to its lower morbidity.^[1-3] PCNL failure is a clinical challenge and the decision to choose additional procedures to maximize stone clearance is at the discretion of endourologists. Less invasive procedures like shock wave lithotripsy (SWL) and ureterorenoscopy (URS) are associated with suboptimal stone clearance rates while open and laparoscopic renal surgery are associated with higher morbidity.^[4] Second-look PCNL is a planned reentry into the pelvicalyceal system for removal of residual fragments after an initial unsuccessful attempt of PCNL.^[4,5] Residual calculi after PCNL have been considered as a Clavien grade 3 complication in view of ancil-

lary procedures required for stone clearance. However, CROES-Clavien scoring system (CCS) stated that unless any intraoperative adverse event such as brisk hemorrhage leading to abrupt termination of the procedure exists, any residual fragment after the best-attempted procedure should not be considered as a complication.^[6,7] Literature evaluating indications and outcomes of second-look PCNL is scarce.^[4] We report the indications, treatment outcomes and complications of second-look PCNL. We also assessed the clinical utility of the CCS for second-look PCNL.

Material and methods

This was a retrospective study from a prospectively maintained database of patients who had undergone PCNL between January 2009 and October 2015 at a tertiary care center in South India which

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Submitted:
30.11.2017

Accepted:
12.03.2018

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Available online at
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is performing approximately 150 PCNL per year. Research review board and Ethics Committee approvals were obtained. Informed consent was not obtained as it was a retrospective study.

Evaluation

Preoperatively hemoglobin, serum creatinine, serum electrolytes, urine analysis, urine culture and ultrasound, plain X-ray of kidneys, ureter and bladder (XRKUB) and intravenous urography (IVU) or computed tomography (CT) of the urinary system were evaluated. XRKUB was performed at 48 hours after PCNL. Urine culture was performed when the patient developed fever.

Parameters

Demographic data included patient's age, gender and Charlson comorbidity index (CCI). Presenting symptoms, urinary tract malformations and prior surgical history were recorded. Stone characteristics like stone size (mm), number, location and complexity, presence of hydronephrosis (HN) and Guy stone score (GSS) were noted. Intraoperative data were related to side of operation, access site (supracostal/infracostal), calyces punctured, number of access tracts, tract size, operation time (OT) and placement of nephrostomy, ureteric catheter or double J stent for drainage. Outcomes including drop in hemoglobin, stone-free status, length of hospitalization (LOH), complications and need for secondary procedures like second-look PCNL or SWL were evaluated. Intraoperative data during second-look PCNL were collected. Outcomes of second-look PCNL including stone clearance, length of hospitalization (LOH) and complications were analyzed. Complications were assigned Clavien scores based on CROES PCNL Study Group scoring system.^[7]

Surgical procedure

All PCNLs were performed at our institute by expert endourologists with at least 5 years of experience. Under general anesthesia, a 21F rigid cystoscope (Karl Storz Endoscopy, Tuttlingen, Germany) was used to insert 5F/70cm ureteric catheter. The patient was turned prone and retrograde pyelography using 76% meglumine diatrizoate (1:2 dilution) as a contrast agent was performed for delineation of pelvicalyceal system under fluoroscopy. The desired calyx was punctured with 18G/15cm diamond-shaped trocar needle and access tract was dilated up to 18F, 24F or 30F depending on the stone complexity, renal anatomy and stone burden. Amplatz sheath of equal size was inserted into the dilated tract and 17F, 22F or 26F rigid Karl Storz nephroscope (Karl Storz Endoscopy, Tuttlingen, Germany) was used respectively for the procedure. Intracorporeal lithotripsy was performed using pneumatic lithoclast (Nidhi Lith Digi, Nidhi Meditech Systems, India). Postoperative drainage was based on intraoperative factors and at the operating surgeon's discretion. Postoperative residual stone status was evaluated by XRKUB at 48 hours. If needed, secondary procedures like second-look PCNL or SWL were performed to obtain maximum possible clearance. Patients with intraoperative bleeding, pelvicalyceal

perforation, purulent urine leading to urosepsis and intraoperative hemodynamic instability and large stone burden were chosen for second-look PCNL as a planned reintervention during the same admission 48 hours after fever or hematuria resolved.

Statistical analysis

The data were analyzed using IBM Statistical Package for the Social Sciences version 20.0 (IBM SPSS Corp., Armonk, NY, USA). The normality of the data was initially assessed using a Box and Whisker plot. The variables were summarized using mean, standard deviation, median, interquartile range, and percentages based on the characteristics of the variable. Student t test (two tailed, independent) or Mann-Whitney U test as appropriate were used for continuous variables based on the normality of the distribution. Chi-square or Fisher exact test was used to evaluate parameters on categorical scale. The P value <0.05 was considered to be statistically significant. In the results, we have denoted patients in whom the initial PCNL was discontinued due to bleeding, pelvicalyceal system perforation, turbid urine and patients with large stone burden with the indication of second-look PCNL (n=78). The primary PCNL group denoted the patients in whom the procedure of initial PCNL was completed (n=844).

Results

A total of 922 patients underwent unilateral PCNL at our institute during the study period. Second-look PCNL was necessary in 78 patients (78/922; 8.5%) and primary PCNL was done in 844 (844/922; 91.5%) patients. The baseline characteristics like age, gender, CCI, serum creatinine, prior treatment for stone disease and renal anomalies were similar in both groups (Table 1).

Preoperative stone characteristics

The mean (\pm SD) stone size was larger (27.7 \pm 9.5 mm) in the patients undergoing second-look PCNL relative to primary PCNL (21.8 \pm 7.2 mm) ($p<0.001$). A significantly higher (47.4%) proportion of patients undergoing second-look PCNL had stones in multiple locations ($p<0.001$), staghorn calculi (30.4%) ($p<0.001$) and highest GSS (Grade IV) grade (30.8%) ($p<0.0001$) when compared to primary PCNL cohort (Table 2).

Perioperative characteristics and outcomes

When the initial PCNL was discontinued, the mean OT was significantly higher (88.6 \pm 31.1 min) in the second-look PCNL group than mean OT of the primary PCNL group (77.4 \pm 25.1 min) ($p=0.03$). A significantly higher proportion (48/78; 62.3%) of the patients needing second-look PCNL had OT >75 minutes while only 38% (321/844) of those undergoing primary PCNL had OT >75 minutes ($p<0.0001$) (Table 3). Total LOH in those requiring second-look PCNL was significantly higher than that in patients undergoing primary PCNL ($p<0.001$). The incidence of complications was higher (53.8%) in patients needing second-look PCNL when compared to that in patients undergoing primary PCNL (25.7%) ($p<0.001$).

Table 1. Baseline patient characteristics

Parameter	Second-look PCNL n=78	Primary PCNL n=844	p
Age, years	42.7±14.4	40.9±15.1	0.67
Gender (M:F)	57:21 (73.1:26.9)	553:291 (65.5:34.5)	0.17
CCI ≥2, N (%)	16 (20.5)	192 (22.7)	0.16
Serum Creatinine (mg/dL)	1.2±0.4	1.2±1.1	0.42
Prior treatment, n (%)			0.10
None	68 (87.2)	674 (79.9)	
Open Surgery	0	32 (3.8)	
PCNL	3 (3.8)	29 (3.4)	
Ureterorenoscopy	5 (6.4)	53 (6.3)	
Shockwave lithotripsy	2 (2.6)	56 (6.6)	
Renal anomaly, n (%)	1 (1.3)	22 (2.6)	0.47
None	77	822	
Bifid renal pelvis	0	4	
Horseshoe kidney	0	6	
Double moiety	0	5	
Autosomal dominant polycystic kidney disease	1	3	
Crossed renal ectopia	0	1	
Malrotation	0	3	

PCNL: percutaneous nephrolithotomy; CCI: Charlson Comorbidity Index

Indications for second-look PCNL

Complications that led to abrupt termination of the initial procedure were bleeding (Clavien I/II - with or without need for transfusion) in 28 (35.9%), pelvicalyceal system perforation in 3 (3.9%) and purulent urine causing urosepsis and intraoperative hemodynamic instability in 2 (2.6%) patients. One (1.3%) patient developed persistent urine leak from nephrostomy site secondary to residual calculus and underwent second-look PCNL. In the remaining 44 (56.3%) patients, second-look PCNL was planned during the same admission as residual stone burden was bound to increase OT.

Operative characteristics in the second-look PCNL

The mean residual stone size (± SD) was 11.1±4.3 mm. The mean operative time was 76.5±19.1 min. During second look, a new access tract was needed in 42 (53.9%) patients with 20

Table 2. Preoperative stone characteristics

Parameter	Second-look PCNL n=78	Primary PCNL (PP) n=844	p
Mean stone size, mm (± SD)	27.7±9.5	21.8±7.2	<0.001
Location of calculus, n (%)			<0.001
Upper pole	0	19 (2.3)	
Mid-pole	1 (1.3)	23 (2.7)	
Lower pole	5 (6.4)	96 (11.4)	
Pelvis	21 (26.9)	402 (47.6)	
Two locations	14 (17.9)	99 (11.7)	
Multiple locations	37 (47.4)	190 (22.5)	
Upper ureter	0	10 (1.2)	
Diverticular	0	4 (0.5)	
Staghorn, n (%)	24 (30.4)	97 (11.5)	<0.001
Presence of hydronephrosis, n (%)	75 (96.2)	718 (85.1)	0.007
GSS, n (%)			<0.001
I	27 (34.6)	519 (61.5)	
II	16 (20.5)	171 (20.3)	
III	11 (14.1)	59 (7.0)	
IV	24 (30.8)	95 (11.3)	

PCNL: percutaneous nephrolithotomy; GSS: Guy Stone Score

(25.6%) patients requiring two or more tracts. Similar number of patients required supracostal or infracostal access. Tract sizes of 24F were used in majority of the patients (62.8%). Nephrostomy was inserted in 47 (60.3%), tubeless PCNL was performed in 26 (33.3%) patients and totally tubeless PCNL was done in 5 (6.4%) patients. Among the 44 patients undergoing staged second-look PCNL due to large stone burden, a new access tract was created in 23 (52.3%) patients. Supracostal access was required for 14 (14/23; 60.9%) of them and multiple tracts in 7 (7/23; 30.4%) patients. However, in 21 (21/44; 47.7%) patients PCNL was performed through the same access tract.

Comparing outcomes and complications of second-look PCNL with primary PCNL

Stone clearance rate after primary PCNL was 79.1% (729/922), which improved to 86.1% (794/922) with second-look PCNL. LOH after second-look PCNL (3.6±1.5 days) was similar to LOH in primary PCNL (4.0±2.2 days) (p=0.381). However, the

Table 3. Perioperative characteristics

Parameter	Second-look PCNL n=78	Primary PCNL (PP) n=844	p
Mean duration of surgery, min (±SD)	88.6±31.1	77.4±25.1	0.03
Duration of Surgery ≥75 min, n (%)	48 (62.3%)	321 (38%)	<0.001
Number of punctures, n (%)			0.001
Single	60 (55)	766 (90.8)	
≥2	18 (23)	78 (9.2)	
Location of punctures, n (%)			0.002
Upper pole	5 (6.4)	143 (16.9)	
Mid-pole	23 (29.5)	253 (30.0)	
Lower pole	32 (41.1)	366 (43.4)	
Diverticular	0	4 (0.5)	
Location of access tract, n (%)			0.68
Infracostal	46 (59.0)	518 (61.4)	
Supracostal	32 (41.0)	326 (38.6)	
Tract size, n (%)			<0.0001
18 F	0	19 (2.3)	
24 F	28 (35.9)	430 (50.9)	
30 F	50 (64.1)	395 (46.8)	

PCNL: percutaneous nephrolithotomy

total LOH in patients needing second-look PCNL (10.9±4.7 days) was longer than that after primary PCNL (p<0.001). Complete clearance of residual stone was obtained in 65 (83.3%) patients while secondary SWL was required for 10 (12.8%) patients in the second-look PCNL group. The other 3 (3.9%) patients had residual calculi of <4 mm in size.

In second-look PCNL, grade I complications occurred in 14 (17.9%), grade II in 6 (7.7%) and grade III in 3 (3.9%) patients respectively (Table 4). But, the rate of complications was much higher (53.8%) after the initially failed procedure (30.8%, 17.9%, and 5.1% complications in patients with Clavien scores of I, II and III, respectively). After second-look PCNL, blood transfusion was required in 2 patients and 4 patients required change of antibiotics for the treatment of persistent fever.

Table 4. Comparison of complications between Primary and Second-look PCNL

Clavien Score	Primary PCNL, n=844 n (%)	Second-look PCNL, n=78 n (%)	p
0	627 (74.3)	64 (82.1)	0.289
1	128 (15.1)	5 (6.4)	
2	58 (6.9)	6 (7.7)	
3	27 (3.2)	3 (3.8)	
4	4 (0.5)	0	

PCNL: percutaneous nephrolithotomy

Intercostal tube drainage was placed for hydropneumothorax in 2 patients and double J stent was inserted to manage pelvical-cyceal system perforation in 1 patient. We observed that during second-look PCNL, the Clavien scores of complications were comparable to primary PCNL (p=0.289) (Table 4).

Discussion

Percutaneous nephrolithotomy is a technically challenging minimally invasive surgical procedure with a significant risk of complications.^[7] The success rates of PCNL decreases with the increasing complexity of the renal stones. Smith et al reported that stone burden, calyceal location, stone count and staghorn stones are the most important predictors of stone-free rate in PCNL.^[8] Turna and associates showed that need for secondary procedures was directly proportional to stone surface area. They reported that 15% of stones with surface area of 500 mm² or less required secondary procedures as compared to 25% of the stones measuring 1000-1500 mm² and 50% of stones greater than 2500 mm².^[9] Numerous scoring systems have emerged to identify the risk factors for treatment failure.^[4]

Knudsen justifies the need for second-look nephroscopy for clinically significant residual renal calculi which can be done in the outpatient facility using flexible nephroscopy as an ambulatory procedure or in the operating room.^[3] Borofsky and associates analyzed outcomes of second-look PCNL following initial treatment failure. Stone characteristics significantly differed between those patients undergoing second-look (n=31) and primary PCNL (n>1200). The incidence of staghorn calculi was higher (61.3%) in patients needing second-look PCNL while only 31.4% of the patients had staghorn stones in primary PCNL cohort. Unsuitable access was the most common (80%) reason for prior treatment failure.^[4] Borofsky et al.^[4] observed that the ultimate stone clearance rate was 97% after second-look PCNL while we observed 86.1% complete clearance rate after second-look PCNL. Secondary SWL was required in 12.8% of these patients. Flexible ureteroscopy and holmium laser lithotripsy

is another option for residual calculi up to mean stone size of 18 mm.^[10] Endoscopic combined intrarenal surgery (ECIRS) is becoming popular for complex renal calculi where primary PCNL can be combined with intraoperative flexible ureteroscopy to reduce the incidence of residual calculi, costs and maximize stone clearance in a single operating session.^[11,12]

Second-look PCNL is performed during the same admission and it ensures more complete clearance of complex staghorn calculi with a lesser need of adjunctive procedures like SWL. This assumes importance in staghorn calculi where persistence of infective nidus leads to more morbidity if patients default. Complications after second-look PCNL are comparable to those after primary PCNL. However, second-look PCNL is associated with prolonged LOH, need of anesthesia, antibiotics and increased chances of antibiotic resistance, causing economic burden of patients.

We had few limitations in our study. It was a retrospective analysis based on case records. We included only those patients with complete medical records. Access tract size was arbitrarily decided. We had analyzed standard and miniature PCNL as one group though the tract size could have made some differences. However whenever a new tract was necessary, an attempt was made to keep the tract smaller. We also intended to perform subgroup analysis with more patients in the future. Though there was no significant difference in the number of anomalous kidneys in the second-look and primary PCNL groups, the unequal proportion of patients precludes any conclusions that can be drawn regarding this issue. Cost analysis between second-look PCNL and other adjunctive procedures will give us a better insight into the economic advantage offered by second-look PCNL.

In conclusion, when primary procedure is discontinued due to bleeding, pelvic perforation or purulent urine coming from access site, second-look PCNL significantly improves stone clearance rates with morbidity comparable to that in primary PCNL. Second-look PCNL is also a planned reintervention for large stone burden offering better stone clearance. Complication rates of second-look PCNL are similar to those of primary PCNL.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Institute of Nephro Urology, Bangalore (INU/RRC/01/2014-15).

Informed Consent: Informed consent was not obtained as it was record review.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.K., V.S.K., R.K.; Design - S.K., V.S.K., A.M., R.K.; Supervision - R.K.; Resources - S.K., V.S.K., A.M., R.K.; Materials - S.K., V.S.K.; Data Collection and/or Processing - S.K., V.S.K., A.M., R.K.; Analysis and/or Interpretation -

S.K., V.S.K., A.M., R.K.; Literature Search - S.K., V.S.K., A.M., R.K.; Writing Manuscript - S.K., V.S.K., A.M., R.K.; Critical Review - S.K., V.S.K., A.M., R.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors have declared that they did not receive any financial support for this study.

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